

## PATENT COOPERATION TREATY

## PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
 US Department of Commerce  
 United States Patent and Trademark  
 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE  
 in its capacity as elected Office

Date of mailing (day/month/year) 08 March 2001 (08.03.01)	
International application No. PCT/EP00/05724	Applicant's or agent's file reference 1800PTWO
International filing date (day/month/year) 21 June 2000 (21.06.00)	Priority date (day/month/year) 25 June 1999 (25.06.99)
Applicant AMADELLI, Rossano et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
 23 January 2001 (23.01.01)

☐ in a notice effecting later election filed with the International Bureau on:  
 \_\_\_\_\_

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Claudio Borton Telephone No.: (41-22) 338.83.38
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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>1800PTWO</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/EP 00/ 05724</b>	International filing date (day/month/year) <b>21/06/2000</b>	(Earliest) Priority Date (day/month/year) <b>25/06/1999</b>
Applicant <b>ITALCEMENTI S.p.A.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (see Box II).

**4. With regard to the title,**

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

**5. With regard to the abstract,**

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

**6. The figure of the drawings to be published with the abstract is Figure No.**

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☒ None of the figures.

# INTERNATIONAL SEARCH REPORT

International Application No

P 00/05724

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 C04B41/50 C01G23/053

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 C04B C01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, COMPENDEX

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 753 980 A (RHONE POULENC CHIMIE) 3 April 1998 (1998-04-03) page 1, line 11 - line 17 page 1, line 34 -page 2, line 26 page 3, line 12 -page 4, line 10 page 5, line 13 - line 32 page 10, line 21 - line 26	1-11, 18-28
Y		12,13, 29,30, 37,38
Y	WO 98 05601 A (CASSAR LUIGI ;ITALCEMENTI SPA (IT); PEPE CARMINE (IT)) 12 February 1998 (1998-02-12) page 8, line 17 -page 10, line 14 --- -/--	12,13, 29,30

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

24 November 2000

Date of mailing of the international search report

01/12/2000

Name and mailing address of the ISA  
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Authorized officer

Mini, A

## INTERNATIONAL SEARCH REPORT

International Application No

P 00/05724

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 05, 31 May 1999 (1999-05-31) & JP 11 049588 A (KAWAI MUSICAL INSTR MFG CO LTD), 23 February 1999 (1999-02-23) abstract ---	12,13, 29,30
X	EP 0 590 477 A (TAKENAKA CORP) 6 April 1994 (1994-04-06) column 2, line 47 -column 3, line 6 column 3, line 55 -column 4, line 16 column 9, line 10 - line 30 ---	35,36, 46,47
Y	---	12,13, 29,30
X	US 5 698 205 A (BRUECKNER HANS-DIETE ET AL) 16 December 1997 (1997-12-16) example 1 ---	52-57,62
X	US 5 049 371 A (RINN GUENTER ET AL) 17 September 1991 (1991-09-17) column 1, line 53 -column 3, line 60 column 5, line 29 - line 68 ---	52-55
Y	EP 0 924 164 A (HOYA CORP) 23 June 1999 (1999-06-23) page 13; table 1 ---	37,38
Y	WO 97 10186 A (BOIRE PHILIPPE ;TALPAERT XAVIER (FR); SAINT GOBAIN VITRAGE (FR)) 20 March 1997 (1997-03-20) page 1, line 25 -page 3, line 9 page 3, line 18 - line 29 page 4, line 23 - line 31 -----	37,38

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 00/05724

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR 2753980	A	03-04-1998	AU 718157 B	06-04-2000
			AU 3547497 A	02-02-1998
			BR 9710247 A	10-08-1999
			CA 2259281 A	15-01-1998
			EP 0910549 A	28-04-1999
			WO 9801392 A	15-01-1998
			JP 2000506487 T	30-05-2000
WO 9805601	A	12-02-1998	IT MI961722 A	09-02-1998
			AU 3940797 A	25-02-1998
			EP 0946450 A	06-10-1999
JP 11049588	A	23-02-1999	NONE	
EP 0590477	A	06-04-1994	CA 2106510 A	23-03-1994
			DE 69311866 D	07-08-1997
			DE 69311866 T	05-02-1998
			JP 6278241 A	04-10-1994
			US 5595813 A	21-01-1997
			US 5643436 A	01-07-1997
			JP 6198196 A	19-07-1994
US 5698205	A	16-12-1997	DE 4329129 A	02-03-1995
			FR 2709482 A	10-03-1995
			JP 7089722 A	04-04-1995
US 5049371	A	17-09-1991	DE 3736686 A	11-05-1989
			AT 88983 T	15-05-1993
			DE 3880785 A	09-06-1993
			EP 0314166 A	03-05-1989
			JP 2022105 A	25-01-1990
EP 0924164	A	23-06-1999	JP 11181129 A	06-07-1999
			JP 11255514 A	21-09-1999
			JP 11255515 A	21-09-1999
			JP 11263620 A	28-09-1999
WO 9710186	A	20-03-1997	FR 2738813 A	21-03-1997
			AU 7087596 A	01-04-1997
			BR 9610604 A	17-02-1999
			CZ 9800784 A	12-08-1998
			EP 0850204 A	01-07-1998
			JP 11512337 T	26-10-1999
			PL 325527 A	03-08-1998
			US 6103363 A	15-08-2000

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

14



Applicant's or agent's file reference 1800PTWO	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/EP00/05724	International filing date (day/month/year) 21/06/2000	Priority date (day/month/year) 25/06/1999
International Patent Classification (IPC) or national classification and IPC C04B41/50		
Applicant ITALCEMENTI S.p.A. et al		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 9 sheets, including this cover sheet.
  - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand  23/01/2001	Date of completion of this report  19.10.2001
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Mini, A  Telephone No. +49 89 2399 8560  

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP00/05724

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-12 as originally filed

**Claims, No.:**

1-21,22 (part), as originally filed  
36-45

22 (part),23-35, as received on 26/07/2001 with letter of 20/07/2001  
46-61

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP00/05724

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

## IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.  
☐ paid additional fees.  
☐ paid additional fees under protest.  
☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.  
☒ not complied with for the following reasons:  
**see separate sheet**

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.  
☐ the parts relating to claims Nos. .

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 12-17, 29-34, 37-45, 48-61
	No: Claims 1-11, 18-28, 35, 36, 46, 47
Inventive step (IS)	Yes: Claims
	No: Claims 1-61
Industrial applicability (IA)	Yes: Claims 1-61



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP00/05724

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No: Claims

2. Citations and explanations  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**

**Re Item IV**

**Lack of unity of invention**

Five separate inventions have been detected:

- |                 |  |
|-----------------|--|
| 1) Claims 1-11  | Use of colourless colloidal preparation of titanium dioxide or one of its precursors.  |
| 2) Claims 12-17 | Use of the preparation of Claim 1 for the oxidation of polluting substances.   |
| 3) Claims 18-34 | A method for preserving the original appearance of cementitious material, stone or marble by treating with colourless colloidal preparations of titanium dioxide.                                      |
| 4) Claims 35-51 | A cementitious, stone or marble product coated with a colourless colloidal preparation of titanium dioxide or one of its precursors  |
| 5) Claims 52-62 | A process for the preparation of a colourless colloidal preparation of titanium dioxide or one of its precursors containing a metal ion chosen from groups I-VA and the lanthanide or actinide series. |

The only feature common to the five inventions is a "colourless colloidal preparation of titanium dioxide or one of its precursors". Such a colourless colloidal preparation is already known from D1 (see page 1, line 34-page 2, line 16; page 4, lines 3-5). The requisites for unity of invention (Rule 13.1 PCT) are therefore not met since the above invention cannot be considered as being so linked as to form a single general inventive concept (Rule 13.1 PCT).

**Re Item V**

**Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. **Preliminary remarks:** The term "*colourless colloidal preparation of titanium dioxide .... or one of its precursors*" as used in claims 1, 18, 35 and 52 is extremely broad in its scope. In the following discussion it is understood as comprising any transparent colloidal composition containing titanium dioxide or any of its precursors.

Similarly the term "*for the conservation (or preservation) of the original appearance*" (as used in claims 1 and 18) can be understood as being directed to eg maintaining the colour, the gloss or opacity, the smoothness or the roughness of the surface and even the physical dimensions or form of the cementitious, stone or marble products.

2. Reference is made to the following documents:

D1: FR,A,2753980  
D2: WO,A,9805601  
D3: JP11049588 (abstract)  
D4: EP,A,0590477  
D5: US,A,5698205  
D6: US,A,5049371  
D7: EP,A,0924164  
D8: WO,A,9710186

3. The subject-matter of **claims 1 to 8** is anticipated by document **D1** which discloses a transparent colloidal (see page 4, lines 3-5) preparation of  $\text{TiO}_2$ , prevalently in the form of anatase, and "containing" as a coating cerium oxide, to be applied on the surface of a construction material as a protection against UV radiation (see D1, page 1, lines 11-17, page 1, line 34-page 2, line 26; page 3, line 12-page 4, line 10; page 5, lines 13-32; page 10, lines 21-26). The results of the comparative examples discussed in the applicant's response of 20.07.01 are questioned. It is, however, stated that
- (i) D1 does disclose a colloidal preparation, and
  - (ii) the wording of claim is so broad to also embrace a titanium dioxide product according to D1
  - (iii) the cerium coating is applied in D1 to protect the  $\text{TiO}_2$  which is considered to be the material with the photocatalytic activity.

The subject-matter of **claims 9 to 11** is also anticipated by **D1** which discloses that  $\text{TiO}_2$  in the form of anatase can be produced starting from precursors such as titanium chlorides (see D1, page 7, line 1-page 8, line 28).

For the same reasons it is considered that **D1** also anticipates the subject-matter of **claims 18 to 28**.

4. Document **D4** anticipates the subject-matter of **claims 35, 36, 46 and 47**. It teaches that a metal-oxide layer exhibiting a photocatalytic activity function (eg  $\text{TiO}_2$ ) is formed on the surface of an inorganic architectural material, including concrete and stone, so as to provide long-term antimold and antisoiling properties. In one embodiment strontium titanate ( $\text{SrTiO}_3$ ) powder is added to a titanium dioxide sol, the sol is applied to a substrate by spin coating and sintered at  $200^\circ\text{C}$  to form a film (see. col. 2, line 47-col 3, line 6; col. 3, line 55-col 4, line 16; col. 9, lines 10-30. It is considered that the term "**sol**" implies the presence of a colloidal preparation. Furthermore, as discussed in the preliminary remarks an "antisoiling" property is considered to fall within the scope of the present invention.
5. Document **D6** discloses a process for the preparation of monodisperse oxide ceramic powders (eg  $\text{TiO}_2$ ) by reacting hydrolysable compounds eg alkoxide of preferably titanium or zirconium with water in an organic solvent and in the presence of a complexing agent. For doping purposes the hydrolysis is carried out in the presence of a small amount of compounds of another element (eg Ca, Mg, Ba, Y, Nb, Ta) which may or may not be hydrolysable (see col. 1, lines 53-col. 3, lines 60; col. 5, lines 29-68). The document does not disclose in which amount the ions are added nor that  $\text{TiO}_2$  has photocatalytic properties. The last is, however, an inherent characteristic of  $\text{TiO}_2$ . Furthermore, it lies in the realm of the skilled person to find the appropriate concentration of metal ions in the colloidal preparation (see also point 7 below). Thus, the subject-matter of **claims 52 to 55** does not involve an inventive step with respect to the combined teaching of **D6** and **D7**.
6. The capacity of  $\text{TiO}_2$  of oxidating  $\text{NO}_x$  and other pollutants as well its application on the surface or in the "bulk" of architectural material for antimolding and antisoiling purposes ie for conserving their original appearance is well known in the art (see **D2**, page 8, line 17-page 10, line 14; **D3**, abstract; **D4** col. 2, line 47-col 3, line 6; col. 3, line 55-col 4, line 16). Thus, it would be obvious for the skilled person to utilize the preparation according to claim 1 of the present application for the oxidation of  $\text{NO}_x$  and other organic pollutants. Therefore, the subject-matter of

**claims 12, 13, 29 and 30** does not involve an inventive step.

7. Titanium dioxide colloidal preparations in which the particle size is between 10 and 200 Å and a sol-gel method for their preparation are known from D1 (see the passages mentioned above). Thus, the subject-matter of **claims 14, 15, 31, 32, 48 and 49** does not involve an inventive step.

The subject-matter of claims 17, 34 and 51 is known from D1 page 10, lines 21-24. Thus, the subject-matter of **claims 17, 34 and 51** does not involve an inventive step.

It lies in the realm of the skilled person to find the appropriate concentration of metal ions in the colloidal preparation (see also point 8 below). Thus the subject-matter of **claims 39 to 40** does not involve an inventive step.

Finally, the features of **claims 16, 33 and 50** are considered to describe well known methods of applying a liquid or colloidal composition (this method would eg be valid also for paints and lacquers).

Document **D1** discloses how  $\text{TiO}_2$  in the form of anatase can be produced starting from precursors such as titanium chlorides and also describes the advantages of using it (see D1 page 1, lines 34-page 2, lines 16; page 7, line 1-page 8, line 28). Thus, the subject-matter of **claims 41-45 and 58-61** does not involve an inventive step.

8. Document **D7** discloses a method for producing titanium dioxide doped with metal ions, which is useful as a photocatalyst having visible light absorbing properties, and a photocatalyst having visible light absorbing properties. **D7** explains that titanium oxide can utilize light with limited wavelength in ultraviolet range but that by doping it with metal ions, the titanium oxide becomes to have visible light absorbing property and to be able to exhibit photocatalytic activity not only with ultraviolet light but also with visible light. Examples of the metal ions for doping titanium dioxide are V, Y, La, Pr, Nd, Sm, Gd, Ho and Yb (see page 13-14, Table 1). Coating layers produced from doped titanium dioxide are transparent, weather resistant and exhibit photocatalytic activity even with light of visible light range.

Thus, the addition to such dopants to  $\text{TiO}_2$  protecting colloidal preparation would be obvious to skilled person. The subject-matter of **claims 37 and 38** does not involve an inventive step.

Similarly **D8** discloses that dopants as those used in the present invention amplify the photocatalytic effect (see page 1, line 25-page 3, line 9; page 3, lines 18-29, page 4, lines 23-31).

**Re Item VIII**

**Certain observations on the international application**

Claims 2, 19, 36 and 52 make reference to metal ions from the groups I-VA. However in the subsequent claims also scandium, yttrium, niobium, vanadium and zirconium are mentioned which do not belong to those groups of the periodic table. In fact, they belong to the groups 3A, 4A and 5A (old IUPAC recommendation) or 3, 4 and 5 groups (IUPAC proposal of 1985) or IIIb, IVB and VB (CAS standards). In order to avoid unclarity is proposed to modify the relevant claims by specifying that metal ions from the scandium or titanium or vanadium group could be contained.

AT 34 AND 1

REPLACE  
ART 29(1)

(percentage expressed as metal-ion atoms with respect to the titanium atoms).

23. A method according to Claim 22, in which the preparations of titanium dioxide or one of its precursors contain the metal ion in an amount of from 0.1 to 1%.

24. A method according to Claim 18, in which the titanium dioxide is prevalently in the form of anatase.

25. A method according to Claim 24, in which at least 75% of titanium dioxide is in the form of anatase.

26. A method according to Claim 18, in which the titanium-dioxide precursor is a product able to produce titanium dioxide prevalently in the form of anatase.

27. A method according to Claim 26, in which the titanium-dioxide precursor is a product able to produce titanium dioxide prevalently in the form of anatase with appropriate types of thermal treatment.

28. A method according to Claim 26, in which the titanium-dioxide precursor is chosen from the group comprising  $\text{TiCl}_4$ ,  $\text{TiOSO}_4$ , and titanium alkoxide.

29. A method according to Claim 18, for the oxidation of polluting substances chosen from the group comprising organic substances present in the environment as a result of motor-vehicle exhaust or industrial emissions, and inorganic compounds.

30. A method according to Claim 29, for the oxidation of nitrogen oxides ( $\text{NO}_x$ ).

31. A method according to Claim 18, in which the titanium dioxide in colloidal form is prepared using sol-gel techniques so as to obtain particles having a size of between 10 and 200 Å.

32. A method according to Claim 32, in which the particles of titanium dioxide have a size of between 50 and 100 Å.

33. A method according to Claim 18, in which an aqueous suspension of the colloidal preparation of titanium dioxide or one of its precursors is applied on the product in small successive amounts until the desired thickness is reached.

34. A method according to Claim 33, in which the colloidal suspension is vacuum-dried so as to obtain a powder which can be re-suspended in water, maintaining its colloidal properties.

35. A cementitious, stone, or marble product, characterized in that it is coated with a preparation of titanium dioxide or one of its precursors.

46. A cementitious, stone, or marble product according to Claim 35, in which a preparation of titanium dioxide or one of its precursors has the function of oxidant for polluting substances chosen from the group comprising organic substances present in the environment as a result of motor-vehicle exhaust or industrial emissions, and inorganic compounds.
47. A cementitious, stone, or marble product according to Claim 46, in which a preparation of titanium dioxide or one of its precursors has the function of oxidant for nitrogen oxides ( $\text{NO}_x$ ).
48. A cementitious, stone, or marble product according to Claim 35, in which the titanium dioxide in colloidal form is prepared using sol-gel techniques so as to obtain particles having a size of between 10 and 200 Å.
49. A cementitious, stone, or marble product according to Claim 48, in which the particles of titanium dioxide have a size of between 50 and 100 Å.
50. A cementitious, stone, or marble product according to Claim 35, in which an aqueous suspension of the colloidal preparation of titanium dioxide or one of its precursors is applied on the product in small successive amounts until the desired thickness is reached.
51. A cementitious, stone or marble product according to Claim 35, in which a colloidal suspension of titanium dioxide or one of its precursors is vacuum-dried so as to obtain a powder which can be re-suspended in water, maintaining its colloidal properties.
52. A process for the creation of colourless colloidal preparations of titanium dioxide or of one to its precursors containing a metal ion chosen from groups I-VA, and the lanthanide or actinide series of the periodic table, and mixtures thereof, characterized in that the hydrolysis of the titanium dioxide takes place directly in the presence of the salt of the metal ion by co-precipitation or mixing.
53. A process according to Claim 52, characterized in that the metal ion is chosen from groups I-VA, and the lanthanide or actinide series of the periodic table, and mixtures thereof.
54. A process according to Claim 53, characterized in that the metal ion is selected from the group consisting of lithium, beryllium, magnesium, scandium, yttrium, lanthanum, cerium, niobium, vanadium, zirconium, and mixtures thereof.



55.A process according to Claim 54, characterized in that the ions are selected from the group consisting of magnesium, cerium, niobium, and lanthanum.

56.A process according to Claim 53, characterized in that the metal ion is present in an amount of from 0.1 to 5% (percentage expressed as metal-ion atoms with respect to the titanium atoms).

57.A process according to Claim 56, characterized in that the metal ion is present in an amount of from 0.1 to 1%.

58.A process according to Claim 52, characterized in that the titanium dioxide is prevalently in the form of anatase.

59.A process according to Claim 58, characterized in that at least 75% of titanium dioxide is in the form of anatase.

60.A process according to Claim 52, characterized in that the titanium-dioxide precursor is a product able to produce titanium dioxide prevalently in the form of anatase.

61.A process according to Claim 60, characterized in that the titanium-dioxide precursor is a product able to produce titanium dioxide prevalently in the form of anatase with appropriate types of thermal treatment.

62.A process according to Claim 60, characterized in that the titanium-dioxide precursor is chosen from the group comprising  $\text{TiCl}_4$ ,  $\text{TiOSO}_4$ , and titanium alkoxide.